Mid-infrared Spectroscopy of Disks Around Classical T Tauri Stars

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We present the first Spitzer Infrared Spectrograph observations of the disks around classical T Tauri stars: spectra in the 5.3–30 μm range of six SED Class II stars. The spectra are dominated by emission features from amorphous silicate dust, and a continuous component from 5 to 8 μm that, in most cases, comprises an excess above the photosphere throughout our spectral range. There is considerable variation in the silicate feature/continuum ratio, which implies variations of inclination, disk flaring, and stellar mass accretion rate. In most of our stars, there is fine structure in the 10 μm silicate feature which suggests the presence of a crystalline component. Detailed modeling of this feature shows quantitative evidence of dust processing in these young (1–3 Myr) Classical T Tauri stars. In one, CoKu Tau 4, no excess above the photosphere appears at wavelengths shortward of the silicate features, similar to 10 Myr old TW Hya, Hen 3–600 and HR 4796A. This indicates a truncation of the inner the disk, a feature suggestive of gravitational influence by planets or close stellar companions; CoKu Tau 4 would be the first star in the million-year-old age range in which such a central clearing is found. We have interpreted the spectrum between 5 and 25 μm as arising from the inner wall of a disk. The disk has an evacuated inner zone and the wall, at $R \sim 10$ AU, receives stellar radiation frontally. This wall consists of an optically thin atmosphere which is responsible for the emission of the silicate bands at 10 and 20 μm, and a colder photosphere from which the longer wavelength radiation emerges.

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